

CONSIDERATIONS REGARDING THE IMPACT PRODUCED ON THE ENVIRONMENT BY THE ARRANGEMENT OF THE WATER RESOURCES

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ABSTRACT: *The accomplishment of the accumulation lakes represents a brutal interference in the balance of that ecosystem, whose consequence may be estimated, prevented and controlled so that, in parallel with the satisfying of the technical criteria which the paper was conceived for, the ecological, aesthetic, social conditions could be provided. The current paper presents aspects referring to the influence exerted by the hydro-energetic arrangements on the environment.*

KEY WORDS: water resources, impact, environment

1. INTRODUCTION

All types of hydro-electric arrangements generally produce beneficial economic effects: obtaining electric energy, stocking water quantities in order to use them as potable water, industrial water or for irrigating some surfaces of agricultural field, recovering certain fields liable to inundation, navigation, reinforcing the tourism, the nautical sports, the industrial fishing and the sports fishing etc. The non-accomplishment of the hydro-energetic arrangement leads to the accomplishment of its purposes by alternative solutions (thermal energy, nuclear energy etc.), which may determine a serious environmental pollution.

The arrangement of the water resources should be made in order to respect the following principles:

a) the economical and social development is indispensable if we want to provide an environmental favourable for the human existence and work and for creating the conditions necessary for improving the life quality on earth.

b) the natural resources of the Earth, including the air, the water, the soil, the flora and the fauna and especially the representative samples of the natural ecosystems should be protected in the interest of the current and future generations by a careful administration or planning, depending on the needs.

c) the Earth's capacity to produce essential resources which may be renewed should be protected and, where appropriate, it may be re-established or improved.

d) the conservation of the nature, especially of the wild flora and fauna, should have an important place in the planning of the economical development

e) in all the countries, we should encourage the scientific research and the technical activities in the context of the environmental problems, and the information, the experimental data and the techniques related to the environment should be made available for all countries, especially for the developing ones [1,5].

The water accumulation in big lakes radically changes the hydrological system, starting with the increase of the level of the

phreatic water layer, the stopping of the slimes, the flooding of a big surface of field and ending by the upstream increased erosions. On the other hand, the huge stocking possibility of the hydro-electric arrangements stops or attenuates the flash flood by protecting the population and changes the negative effects of a calamity into positive effects by producing energy.

The current measures for administrating the waters and for protecting the environment are not enough for solving the problems of quality damage of the waters of the accumulations by their accelerated eutrophication. The eutrophication is the process by means of which, due to an increase of the concentration of the nutritive substances of the water, the vegetal organisms are excessively developed. Thus, there is a lack of balance in the circuit of the matter and of the energy of the respective aquatic basin, incarnated by the accumulation of organic matter in time [4].

2. THE IMPACT OF THE WATER RESOURCES ARRANGEMENTS ON THE ENVIRONMENT

The main influence fields of the hydro-technical works on the environment are the following: the economical-social one, the geophysical one, the water quality, the flora and the fauna.

Elements regarding the economical and social impact. The construction of a hydro-technical arrangement and particularly of a dam creates many new workplaces. They are temporary, but in case of the big dams, their duration may usually be up to a decade. One of the disadvantages related to the accomplishment of the big hydro-technical arrangement is the population's migration from the areas that are to be flooded by the accumulation lakes. The adversaries of the dam state that the populations which had migrated lose their traditions and culture, and the compensations they receive are inadequate. When there are archaeological and historical vestiges, cultural and religious monuments in the placement, these should be conserved, usually by moving or rebuilding

them outside the arrangement area. They should allow to the current and future communities to keep the connection to their past, particularly regarding the technological evolution and the resource exploitation.

The social acceptance has become in time a component more and more important for promoting some new projects. This involves the initiation from the starting phases of the projects, of certain programs containing information, education, persuasion of the population and of the local authorities on the project advantages [8].

The geophysical effects may occur in time both on a short term and on a long one, and they may extend in space much beyond the physical limits of the arrangement. The specific geophysical processes are the following: clearing and draining the accumulation area, establishing the versants, the river flowing system and the transport of sediments, the induced seismicity.

The basin cleaning of the future accumulation lake from trees and bushes in a general or selective manner should be carefully analysed for avoiding the future problems generated by the lake exploitation. The decomposition of the organic waste affects negatively the water physical-chemical properties. The versants with evolving or potential landslides should be stabilized before the filling of the lake. The filling of the lake and the level variation in lake have unfavourable effects on the versant stability and they may lead to the unleashing of new landslides. In all cases, it is recommended the monitoring of the landslides and, where appropriate, the accomplishment of stabilizing works which may sometimes be very expensive. The shore erosion produces a bigger transport of sediments in the deeper areas of the accumulation. The erosion and the leak of mineral and organic materials such as the peats may cause the release of chemical compounds. After these processes, the lake water contains increased quantities of iron, phosphor, nitrogen, dissolved materials and organic matters in suspension [3].

The impact of the arrangements of the accumulation lakes on the water quality and on the climate. An accumulation

lake influences the water quality in every accomplishment phase (filling, exploitation). In the filling phase, the minerals released from the flooded soil and the decomposition of the organic waste have important consequences on the physical and chemical properties of the water. Additionally, the exploitation graphic of the big accumulation lakes leads to changes in the thermal stratification and the distribution of the dissolved oxygen which also changes the chemical properties of the water and of the sediments. In extreme cases, the presence and the exploitation of an accumulation may accelerate the aging rate of the water mass and its eutrophication, affecting different uses. The proliferation of the algae and of other aquatic plants leads to an accumulation of vegetal biomass and detritus, generally causing the damage of the water quality. In the accumulations with long periods of time of keeping the water (yearly cycles of filling – depletion) and with water depths beyond 10 m, there will be a frequent thermal stratification. The stratification is generally caused by the differences of water density, since they are produced by the differences of temperature, salinity, turbidity, sediment charging and other parameters of water quality. The accomplishment of retention on a river generates many phenomena changing the chemistry of the river waters and, as a consequence, the chemical properties of the accumulation water and of the water evacuated by the dischargers from the dam are frequently different from the ones which were in a natural system. The changes depend on factors such as: the nature of the flooded field, the chemistry of the affluent waters, the stagnation time of the water in the lake, the thermal structure of the lake, the climate in placement, the lake morphology. The filling of the lake and the prolongation of the stagnation time of the water into the lake changes the content of the nutritive elements in the water, its mineralisation degree. At the same time, these phenomena tend to stabilise across a long exploitation time of the accumulation. A high content of oxygen dissolved in the water is very important for the aquatic life. At the same time, in case of

reduced oxygen concentrations, in the accumulations where the sediments contain heavy metals, it is possible to release toxic substances as a consequence of certain chemical reactions. The oxygen content in a new accumulation essentially depends on the decomposition of the organic matter in the soil, not on the flooded vegetation, on the chemical or biological oxygen request, on the re-aeration capacity of the lake, on the oxygen production of the aquatic vegetation and on the quantity of substances transported from upstream or on the natural mixture of the water. The oxygen content dissolved in the new accumulations is very low because of the high consumption of the flooded vegetation, but the generally is generally improved after the third year since the filling.

The contamination degree of an accumulation with toxic or damaging substances depends on the nature of the flooded fields, the substance contribution from the riverside communities, the balance between absorption and desorption of the pollutants existing in the sediments. The dissolved oxygen quantity influences strongly the release of toxic and damaging substances [6,7].

The impact on flora and fauna. The inundations and the nutrient leaks from the flooded soil usually produce an important increase of the biologic activity in the accumulation lake. This increased biologic activity known as “the effect of lake filling” is prominent especially in the areas where the bio-nutrients are naturally produced. This way of obtaining some increased productions of fish and of other aquatic creatures is commercial, either directly as a food source, or indirectly by developing recreational or commercial activities. “The effect of lake filling” is manifested on a long term, more than 30 years in usual conditions, until reaching the balance. The lake filling could also cause some negative phenomena. In some cases, it may cause the excessive increase of the algae or the eutrophication. The accomplishment of the accumulation may cause a change of the balance existing between the species living in the respective area. The inundation of the dry or humid

lands and the control of the debits discharged downstream the dam may sometimes change the composition of the resident species. Upstream the dam, the ecosystems will change from the stream (lotic) ones to the lake (lentic) ones. The artificial accumulation present only partially the features of a natural lake because the temperature, the level of dissolved oxygen and other important parameters may be different from the ones of a natural lake. The accumulations may also have negative effects on the migration of some creatures, when the dam stops their usual migration routes. Other threats on the migrating creatures are related to the reduction of the areas of food supply, of the reproduction areas [2].

Case study. Influence of the hydro-energetic arrangement of Vadeni-Tg. Jiu on the water quality of Jiu river

The influence of the hydro-energetic arrangements of Vadeni-Tg. Jiu on the water quality of Jiu river may be evaluated by monitoring the physical-chemical indicators in two control sections: the middle section (Vadeni – Targu Jiu) and the dam section.

The evolution of the MS, OD, CBO₅, pH indicators of Jiu river in 2011-2012 for Vadeni – Targu Jiu section is presented in fig. 1-4.

The results of the determinations for the “matters in suspension” indicator (fig. 1) is framed within the stipulations of the valid normative, and the admitted limit value is 35 mg/dm³.

The measured values for the “dissolved oxygen” indicator are over the 7mgO₂/l limit, according to the 2nd quality class surface waters, according to the Order 161/16.02.2006.

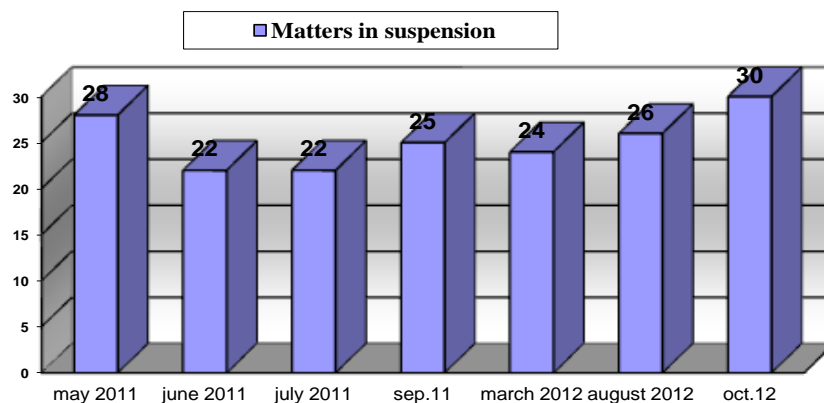


Fig. 1. The evolution of the matters in suspension (MS) in the middle section.

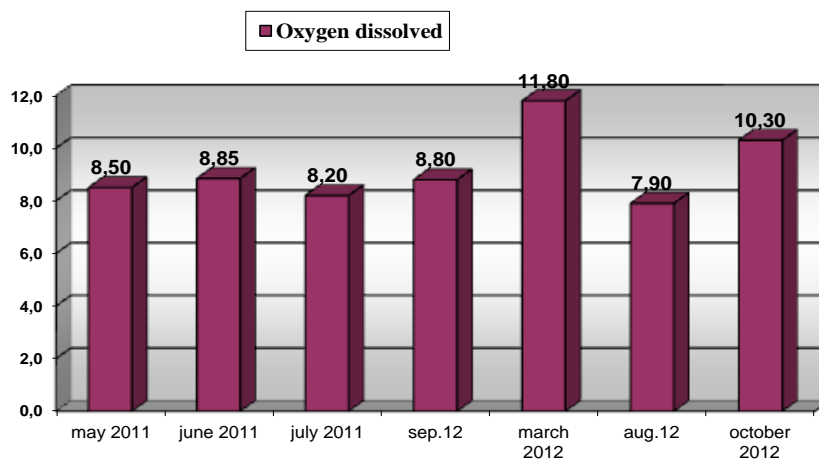


Fig. 2. The evolution of the dissolved oxygen (OD) in the middle section.

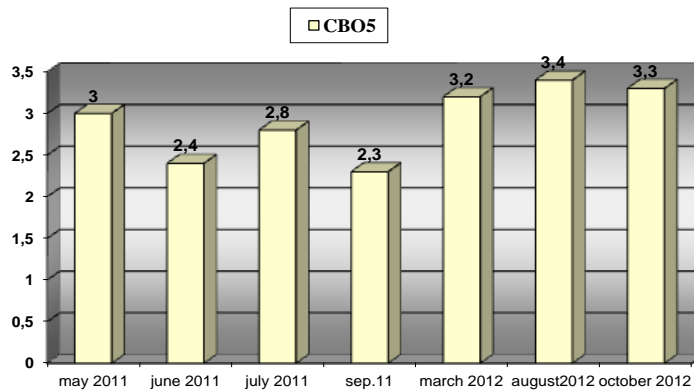


Fig. 3. The evolution of the biochemical oxygen (CBO₅) in the middle section.

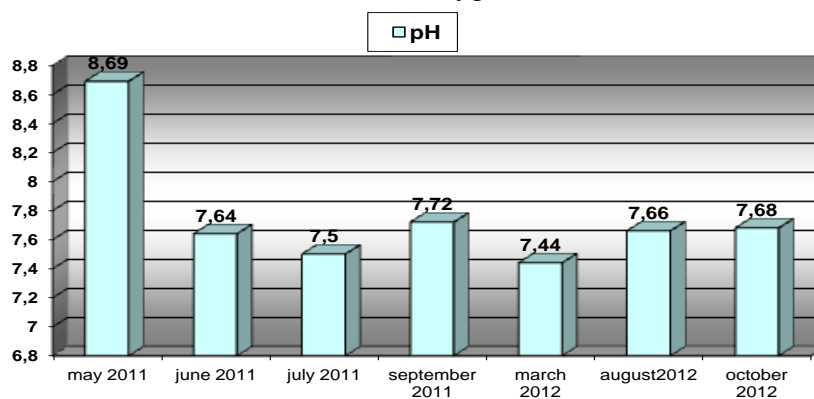


Fig. 4. The evolution of the pH in the middle section.

The results of the determinations for the “CBO₅” indicator (fig. 3) do not exceed the admitted limit value (25 mgO₂/dm³), stipulated by the valid legislations and the pH values are framed within the 6,5-8,5 field, except for the month of may 2011, when there was a slight overflow.

The evolution of matters in suspension and biochemical oxygen quality indicators of Jiu river in 2011-2012 for the middle section (Vadeni – Targu Jiu) and the dam section is presented in fig. 5-6. For the monitored indicators, we may notice that the values determined in the dam section are almost similar to the values determined in the middle section.

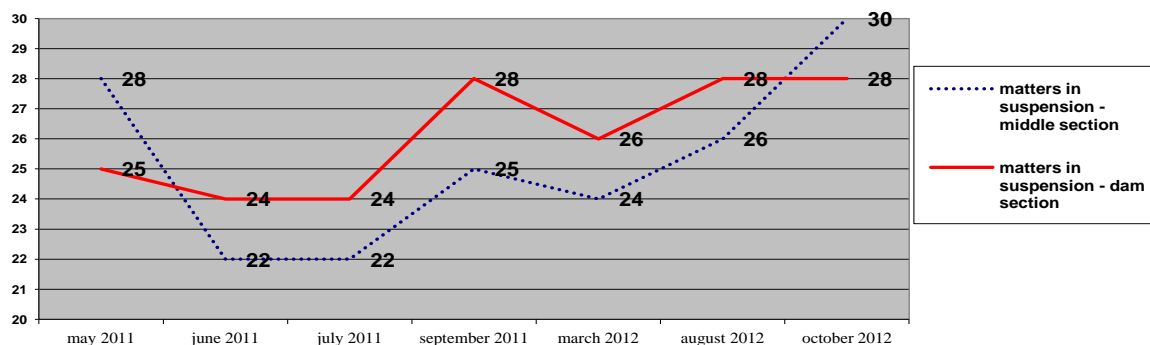


Fig. 5. The evolution of the matters in suspension (MS) for the middle section and dam section.

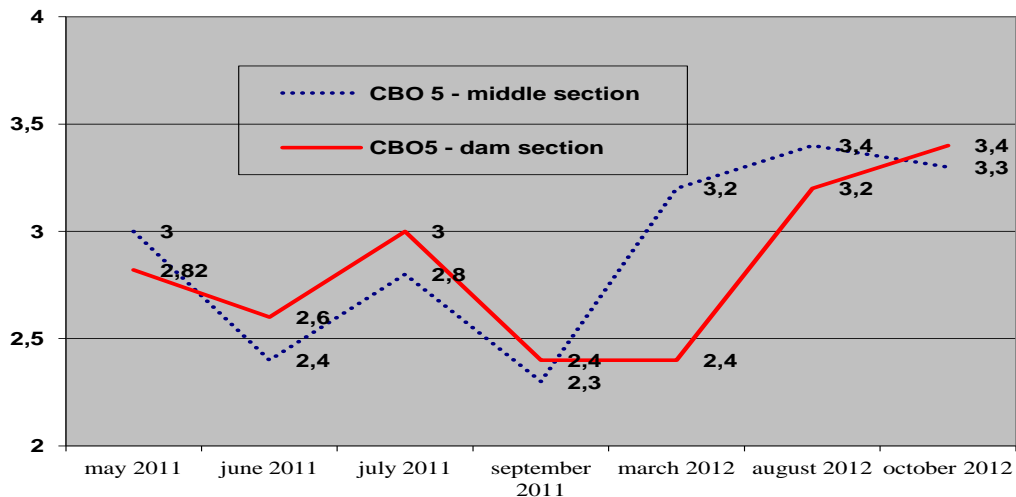


Fig. 6. The evolution of the biochemical oxygen (CBO₅) for the middle section and dam section.

3. CONCLUSION

By accomplishing a hydro-energetic arrangement and the afferent industrial installations, by developing the tourism and the leisure and generally by the economical development of the area, it is created an important number of workplaces which may overreach the local possibilities. One of the most disputed problems related to the accomplishment of the big hydro-technical arrangements remains the one of the population's migration from the areas that are to be flooded by the accumulation lakes. This situation should be avoided as much as possible, by studying many different options from the perspective of the surface of the accumulation lake and by choosing an option which is less adequate from the energetic-economical viewpoint, but whom the expropriated surface is minimal for.

The negative effects of the impact of the hydro-energetic arrangements on the environment may be improved by adapting some measures which are easy to apply and need no great expenses. Only a well done multi-criteria analysis may reveal the real size and the long term consequences of the impact produced on the environment by the arrangement of the water resources and implicitly the opportunity of the stipulated measures of improvement.

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